Apparatus, Methods, and Systems for Digital Photo Management

Inventors: Michael Slater,

Ken Rothmuller, and Bernard Peuto

CROSS REFERENCE TO RELATED APPLICATIONS

This application claims priority from the following provisional patent applications, the disclosures of which are herein incorporated by reference for all purposes:

1. U.S. Provisional Patent Application Ser. No. 60/179,379, entitled "DIGITAL PHOTO MANAGEMENT INTERNET APPLIANCES AND ASSOCIATED METHODS AND SYSTEM," Michael Slater et. al., filed Jan. 31, 2000; and

2. U.S. Provisional Patent Application, entitled "PHOTO JOURNAL USER INTERFACE," Ken Rothmuller et. al., filed Jan. 16, 2001.

Field of Invention

This invention relates to management of collections of digital photos and to associated user interfaces.

Background

It is expected that the huge consumer photography market will make a massive technology transition during the next decade. Driven by fundamental technology trends, digital cameras will steadily and rapidly take over the majority of the camera market. Just how fast this transition will occur is a subject of some debate, but there is little doubt that the transition will take place. It is estimated that 4.7 million digital cameras were sold worldwide in 1999, and that this figure will increase to 22 million in 2003.

Today, using a digital camera is impractical if you are not a capable computer user. This is because digital camera users are presently required to manage their digital images using the hierarchical-directory file-centric paradigm that is native to present personal computers. Some printers can connect directly to a camera or read flash memory cards to access pictures, but computer skill is still required to store and manipulate the pictures. Photo-sharing Web sites, which have proliferated in great numbers, provide valuable services for digital camera users but are only part of a complex solution currently suitable only for the computer sophisticate. Photo-printing sites again provide only part of the solution. As digital cameras become mainstream, the limitations of file-centric management of digital photos could become crippling.

As digital cameras spread beyond photo enthusiasts to snapshot takers, there will be many potential camera customers with no desire (or ability) to deal with computer-specific technical details. What is needed is a digital photo solution with appliance-like simplicity, which snapshot takers will be capable of using and want to deal with, and which can access the Internet to perform comprehensive end-to-end digital photo management.

Previous Computer Based Solutions.

Digital photo-management functions are done today by personal computers. To do so, however, requires an assortment of programs and peripherals. The complexity of the task includes learning each of the programs, managing hierarchical directories of photo files, dealing with a printer, finding printing services, and ensuring reliable backups. It is far too cumbersome, daunting, and hard to learn for typical photo consumers (not enthusiasts) to adopt in significant numbers. File-centric personal-computer-based photo management no doubt will improve greatly in the coming years, but the file-centric paradigm is very unlikely to evolve rapidly into one that most snapshot consumers will find satisfying. Digital cameras will become pervasive, but they need a much better companion photo management solution than the file-centric approach to achieve this goal. What is needed is a comprehensive end-to-end unified digital photo management solution for typical photo consumers.

Personal computers have significant capabilities for working with digital photos. They typically have large screens, which provide for dramatic viewing and allow many pictures to be seen at the same time. Photoediting programs on personal computers offer extensive capabilities, although very few people have the skills to use

such programs or want to invest the amount of time required in each picture. Today, the person who edits photos on their personal computer is more akin to a home darkroom enthusiast than to a typical photographer. What is needed is a means for a typical photographer to enjoy the fruits of extensive photoediting capabilities with minimal effort, training, or investment.

Personal computers also provide significant flexibility to create photo albums, Web pages, and other publications. Today's software requires that such creations either conform to very simple templates or that the user have a high-end design program and the talent to use it. For the most part, however, the more sophisticated capabilities are beyond what most photo users are interested in. What is needed is a means to enable most photo users to publish their photos in a wide range of electronic and print formats with minimal effort, training, or investment.

A notebook computer is a portable platform that can be used to share photos. Because of its physical clumsiness, however, taking out a notebook at a gathering to pass around is quite awkward. The keyboard gets in the way, and it is not easy for users to browse through a "stack" of photos. What is needed is a portable platform for sharing photos that is easy to pass around and permits users to easily browse a stack of photos.

Pen-based computers designed for field workers, such as those made by Fujitsu, Casio, and Mitsubishi, are candidates for use in digital photo management. However, such devices have all the same ease-of-use barriers inherent in conventional personal computers—in addition to being too expensive. The industrial tablet computers are

expensive (typically $2,000 and up) in part because they use large LCD displays. These devices also lack interfaces that are desirable for digital photo users, such as SmartCard and Memory Stick interfaces, and, in some cases, audio input/output and TV/monitor output interfaces. What is needed is a computer solution with appliance-like simplicity for digital photo management that inexpensively provide easy, convenient, and robust operation. What is further needed is a computer solution for digital photo management that includes interfaces for removable memory, audio, and TV (or other video).

Photo Sharing and Printing Web Sites

There has been a proliferation of photo-sharing and printing Web sites, such as ofoto, zing, gatherround, shutterfly, activeshare, photopoint, photoloft, photoisland, clubphoto, and iprint. Most of these sites will store arbitrary numbers of photos for the user. Most broker print services, while others are primarily front ends for internal printing operations.

Unfortunately, these Web sites are only part of a complex solution currently suitable only for the computer sophisticate. Photos must be manually uploaded to the site; they have no concept of maintaining a synchronized archive. The sites are built around a focus of sharing selected photos, not of managing all your photos for your own use. Interacting with them is slow and tedious unless the user has a fast Internet connection. Even with a fast connection, loading a significant number of pictures is time consuming, and the browser interface does not provide an easy or reliable method for doing this in the background. What is needed is an Internet-based service

for digital photo management that provides an easy and reliable means of managing synchronized photo archives for individuals, including the capability for automatic background photo transfers (uploads and downloads). (Such a digital photo management service would likely also offer photo sharing and photo printing services.)

Camera-Printer Systems

Several makers of photo printers, recognizing the difficulties of current computer-reliant solutions, support direct printing of photos without using a computer. In some cases, the camera is connected to the printer via a serial interface, or sends the image data via IR (infrared); in others, the memory card is removed from the camera and inserted into the printer. The printer can automatically generate an index page and then produce prints in the selected sizes and quantities.

This approach has two major limitations. First, it provides no way to store the pictures. Flash memory cards are far too expensive to use as a long-term storage medium, and in any case keeping the pictures organized would be quite problematic. Second, this approach is limited to local printing. Although prints from low-cost photo printers have become very good, they are still not quite the same as a silver halide print, and they are time-consuming and expensive to produce. Many users will prefer to use Internet-based printing services, which will deliver prints in a day or two using conventional photo paper with very little hassle. What is needed is a long-term storage solution for digital photos that additionally facilitates printing either via a local printer or via a remote printing service.

Camera-Internet Interfaces

There are products in development that will enable cameras to communicate directly with photo-sharing Web sites, allowing photos to be uploaded without use of a personal computer. FotoNation, which was acquired by Zing, has announced plans to sell such a product under the name FotoCall. These products could be useful for sending images while traveling, but since they provide no photo display without using a computer (or other Web access device), it does not provide a complete solution.

Zing, FotoNation, and Casio have developed personal computer software that will automatically upload photos from a camera connected via USB and transfer these photos to the Zing site without user intervention and without putting the photos on the computer's hard drive. This solution provides no mechanism for locally managing your photos.

Some camera makers are expected to include modems in some future cameras, enabling the camera to communicate directly with a photo-sharing site. The lack of any local storage for the photos, however, combined with the time-consuming transfers that keep the camera busy, are likely to make this an unappealing solution for most users. What is needed is an appliance-like solution for digital photo management and associated services that: provides for programmed photo transfers to and from remote storage without requiring direct user supervision, does not reduce camera availability, and does not require the user to be a computer sophisticate.

Photo Management Systems

There are commercial photo-management systems, such as Digitella's IntelliPix, that maintain photo archives and will synchronize the archive with other devices (typically personal computers). Such systems use off-the-shelf hardware and are designed for large commercial users, such as real estate agents. The genesis of theses systems in the commercial environment will make it difficult for them to reach the cost and ease-of-use points needed for the consumer market. What is needed is a consumer-oriented digital photo management system supporting synchronized digital photo archives.

Portable Photo Viewer Devices

A portable photo viewer product has been sold by VideoChip Technologies, but it simply displays pictures from a memory card and provides no storage or printing functions. Priced at $399, VideoChip's "Wallet" viewer with a 4" diagonal display became available in June 2000. The company plans other products with larger displays but has no announced plans for products with mass storage or photo-organizing or enhancement functions, nor is there any Internet connection. Panasonic, Samsung, and others have showed concept prototypes of Flash-memory-based viewers.

Sony offers an $899 digital photo frame (called the Cyberframe) that provides some digital photo management functions in a desktop device. As with the portable photo viewer, however, the Cyberframe provides no solution for long-term storage, organization, or use of Internet services. It also supports only Sony's Memory Stick storage cards. What is needed is a portable photo viewer that incorporates

functionality for display, long-term storage, printing, photo-organizing, photo enhancement, and access to associated Internet services.

Brief Description of Drawings

Fig. 1 is a system diagram showing a photo-journal client (such as a photo-tablet or a photo-journal application running on a personal computer) and photo management server (a tablet-server), interconnected via the Internet, and in accordance with the present invention.

Fig. 2 is a block diagram of a photo display and management tablet (a photo-tablet) in accordance with the present invention.

Fig. 3 is a system block diagram illustrating the use of a conventional TV for displaying photos managed on a photo-journal client platform.

Summary

The present invention teaches the use of an optimized digital photo management user interface, referred to as the photo-journal UI (PJUI). The PJUI is a client user interface intended for use with a companion server, referred to as a tablet-server. The PJUI is implemented in two illustrative and alternative client embodiments, a photo-journal application, and a photo-tablet. The photo-journal application runs on general-purpose personal computers as a client application implementing the PJUI. Depending on the form factor and available human interface I/O, the PJUI of the photo-journal application may be further optimized as appropriate. The photo-tablet is a dedicated portable client device with a small-screen optimized PJUI.

The photo-tablet is designed to be an intermittently connected Internet-appliance. In the photo-tablet, the small-screen optimized PJUI runs entirely on the photo-tablet, even for actions involving the server. Thus the photo-tablet does not require a separate personal computer, web-browser, or other Internet access means. The photo-journal application client isolates the lay user from computer-centric technical details. The photo-journal application client also may be configured for intermittent (deferred) access.

User requests for network services (e.g., printing) are queued in either photo-journal client until the next connection. When a photo-journal client is connected to the Internet, it finds a tablet-server, identifies itself, uploads any new photos, and uploads any orders for prints or other services. Photo-journal client software is automatically updated by the server to track changes in features and options. Photos that have been

added to the tablet-server from other sources, such as a film processing and scanning provider or uploaded over the Internet from personal computers, are automatically downloaded to the photo-journal client. If a photo archive is maintained on the tablet-server, then the photo-journal client preferably maintains a photo cache subset. However, market research as determined that many users are uncomfortable with either a partial or complete remote archive, so the user's photo archive may instead be archived on the photo-journal client, either exclusively, or redundantly with the tablet-server. The foregoing system features are illustrated in Fig. 1.

This instant application focuses primarily on the photo-tablet embodiment, which was initially detailed in U.S. Provisional Patent Application Ser. No. 60/179,379, entitled "DIGITAL PHOTO MANAGEMENT INTERNET APPLIANCES AND ASSOCIATED METHODS AND SYSTEM," Michael Slater et. al., filed Jan. 31, 2000, also as previously incorporated by reference. The PJUI architecture generally, and its use as in the photo-journal application embodiment, are detailed as provided in U.S. Provisional Patent Application, entitled "PHOTO JOURNAL USER INTERFACE," Ken Rothmuller et. al., filed Jan. 16, 2001, as previously incorporated by reference. Differences may exist between the applications with respect to various user interface features. Unless indicated to the contrary, the Jan. 31, 2000 application and this instant application may have features more specifically optimized to a small-screen portable platform, while the Jan. 16, 2001 application is generally more platform-generic but reflects a greater experience with the user interface design. Those skilled in the art will be able to pick and choose features from the two applications based on this knowledge and in view of their particular implementation constraints.

For small-screen portable platforms, a fully dedicated hardware implementation of the photo journal user interface, such as provided by the photo-tablet, is a preferred approach for those applications in which performance and portability are both very important. While the costs are expected to decrease rapidly over the next few years, the present cost of the dedicated hardware implementation is expected to limit the overall market for such a device. A fully software implementation of the photo journal user interface, such as provided by a photo journal application running on a desktop personal computer, is a preferred implementation if a larger market reduced cost solution is desired.

Another small-screen portable platform solution is to implement the photo journal application on pen-based handheld-platform that have sufficient resolution to permit enjoyable casual viewing of color digital photos. (An example of such a platform is the Compaq iPaq running the Microsoft PocketPC OS). This solution provides the benefits of the photo-tablet form factor and does not incur the cost of the fully dedicated hardware embodiment. This solution is a compromise in that computer-specific technical details are only hidden from view only while the photo-journal application is running. Such platforms are also presently quite expensive by themselves, such that this market is also quite limited in size.

In the context of the foregoing, the instant patent application makes many comparative references between the photo-tablet and photo management solutions based on the PC. Unless explicitly indicated otherwise, for economy of presentation, references to PCs and PC-based solutions refer to prior personal computer approaches (of any OS and machine vendor type) that are not based on the photo-journal user

interface and are not found in the handheld form factor. Those skilled in the art will be able to easily appreciate which of these comments are not applicable to a photo-journal application running on a desktop or handheld PC.

A photo-tablet, in accordance with the present invention, is intended to satisfy the diverse digital photo management needs of typical next-generation digital photo consumers. The needs satisfied by the present invention include:

a system enabling users to share their photos with others that requires no technical computer skill and is easy for lay users;

a system enabling users to share their photos with others that decouples the user's requests to perform sharing from the underlying communications processes that actually perform the sharing;

a system enabling users to share their photos with others that neither requires immediate execution of the underlying communications processes, nor requires attended operation during the communications processes;

a portable photo viewer for sharing photos that is easy to pass around and permits users to easily browse a (virtual) stack of photos;

programmed automatic background photo transfers with optional remotely networked long-term storage for maintaining synchronized photo archives for individuals;

inexpensive equipment and services that have easy, convenient, and robust user operation, but do not require direct user supervision for task execution, do not reduce effective camera availability to the user, and do not require the use of a PC;

local interfaces for removable memory, and, in some cases, audio, and TV (or other video);

printing via either a local printer or a remote printing service;

enjoyment of extensive photo-organizing and photo enhancement (photoediting) capabilities with minimal effort, training, or investment; and

publishing of user photos in a wide range of electronic and print formats and to a wide range of destinations with minimal effort, training, or investment.

The apparatus, systems, and methods for digital photo management in accordance with the present invention, include, but are not limited to: Internet appliances, Internet servers, networked collections of multiple appliances and servers, Internet-enabled services, transaction protocols, associated subsystems, associated program methods and data structures, and associated signals-in-flight and media.

The photo-tablet provides a complete, streamlined, easy-to-use, and highly effective solution to digital photo management. It is a photography information appliance that stores photos, displays them, and works in concert with an Internet server—accessed automatically by the photo-tablet—for backup, extended storage, and printing.

The photo-tablet serves as a portable photo album with a (virtualized) vast store of photos. It is a comprehensive solution to the needs of digital camera users, eliminating the complexity of a PC. In addition to all the other benefits of digital photography, it solves a widespread problem that plagues both digital and film camera users: how to organize and share your photos—not just over the Web, but also in person, wherever

you are. It also provides all the benefits of Web-based photo sharing sites and printing services in a faster and easier way than using a PC.

The photo-tablet has fundamental advantages over a PC-based digital photo management approach. It has exactly the interfaces and software needed, in the smallest practical physical configuration, with integrated Web support. Not only does a photo-tablet do most of what a user would do with a PC, with a superior user interface; it also provides a portable means of displaying photos and offers a complete solution for digital photo management.

With a digital camera and a photo-tablet, or a hybrid photo-tablet/camera, consumers can easily store and organize their pictures. It provides secure long-term storage with virtually no effort. The photo-tablet need only be occasionally connected to the Internet, and it will automatically archive new photos to the tablet-server and process requests for prints. No browser is needed; interactions with the server are handled automatically by the photo-tablet. The user interface runs offline on the photo-tablet, making it very responsive and hiding all the delays of Internet access.

The photo-tablet enables users to create simple, elegant albums, and special companion Web sites will provide automatic creation of Web pages. The photo-tablet enables users to have access to all the capabilities of these sites without the need for a PC. Because the user interface runs off-line and the Internet connection is designed to run intermittently without user intervention, it will be more pleasing to use. The user interacts with the photo-tablet; the photo-tablet interacts with the server in the

background. And, of course, the photo-tablet provides a portable device for viewing photos anywhere.

A photo-tablet may be as small as a paperback book or as large as a magazine, depending on the display size. Fig. 2 shows an illustrative embodiment that includes an LCD display with touchscreen, slots for various types of memory cards used in digital cameras, and a hard drive to store photos. The illustrated embodiment also provides a USB interface for an optional local printer, or for direct connection to a camera. The embodiment shown also includes NTSC (TV) and RGB (monitor) outputs to allow photos to be viewed on a larger screen. The photo-tablet also preferably includes some manner of network connection, such as the illustrated modem port for a dial-up Internet connection, or an Ethernet or Bluetooth link to a network gateway that couples to a LAN, intranet, or the Internet.

Fig. 3 illustrates how the photo-tablet of Fig. 2 may display photos on a TV without a direct cable coupling. Here, the photo-tablet is directly coupled to an interface that couples via a data link (such as a wireless or powerline data link) to a set-top box coupled to the TV.

Many different devices can be built with different cost/size/feature tradeoffs. A first illustrative embodiment includes a roughly 4" x 6" display, mimicking the size of a common print while minimizing size and cost. A second embodiment, designed to be used mostly at one location but to roam freely within a modest distance, is a device with a 10-14" display and a wireless connection to a base station. The base station translates the wireless link to an Internet connection and serves as a charging stand for the photo-tablet. Initial photo-tablets will use such small displays, because of their

reduced cost. Embodiments of the photo-tablet designed primarily as desktop (or wall-mounted) viewing devices are also in accordance with the present invention.

The photo-tablet provides everything a consumer needs to easily store and organize their pictures, share them with friends in person or via the Web, and get prints either from their own printer or a service bureau. The user needs only to provide a phone line or other Internet connection periodically, and the photo-tablet will automatically archive any new photos to the tablet-server and process any requests for prints or other services. No browser is needed; the user interface runs offline on the photo-tablet.

The photo-tablet makes it easy for a user to share photos, in person as well as via the Web, without prints. Today, this can be done at a PC, but there is no convenient way to take pictures to a friend's house, or even to the living room.

The primary benefits of the photo-tablet include:

- Easy management of all the user's photographs
- Sharing of photos in person, at any location
- Automated off-site backups for secure long-term storage
- Easy access printing services and Web sharing sites

A photo-tablet can work with a PC, for users who want to use PC-based photo manipulation programs. The photo-tablet can connect directly to the PC and, through a small utility running on the PC, maintain a synchronized image database on the PC. All the benefits of the photo-tablet, including automatic off-site archiving, easy access

to print and sharing services, and portable display of photos are available to the PC user as well.

Because digital cameras are still more expensive than film cameras, and because the process of getting prints is much more complex, digital photography is currently limited to an enthusiast market. Only early adopters are willing to put up with the complexity and clumsiness of managing their photographs using a PC. The photo-tablet provides the first truly easy to use, complete solution for digital photography.

Digital camera users today are, by definition, computer literate enough to manage their photos on a PC. But many of them will prefer the simple, portable, reliable, and effective solution offered by the photo-tablet. Even if they continue to use a PC for photo editing or generating publications, the photo-tablet is valuable as a portable viewing device, and photo-tablet software running on the PC will ensure automatic back-up to the Web site. The photo-tablet can also be used to collect photos in the field, enabling an arbitrary number of pictures to be stored by periodically loading the pictures from the camera to the photo-tablet. It makes a great companion to a PC for users who are already adept at using a PC to work with photos.

Another advantage of the photo-tablet is its superior user interface and integration. PC photo-management products typically are clumsy and overburdened with features, and often several products must be used to perform the tasks performed by the photo-tablet. The photo-tablet approach provides easy categorizing of photos and automated assembly of virtual photo albums that is superior to any PC software product available today.

Detailed Description

Photo-tablet Operation

A illustrative photo-tablet usage scenario is as follows:

- Photos are removed from digital camera on a memory card
- The memory card is inserted in the photo-tablet
- The photo-tablet automatically loads the pictures on to its hard disk
- User browses the photos, adjusts or deletes photos as needed, assigns keywords, and optionally records voice annotations
- The next time the photo-tablet has Internet access, the new photos are automatically uploaded to the tablet-server

In an illustrative embodiment, the photo-tablet software allows the user to enter keywords in four categories: people, things, events, and places. Each photo is also tagged with a date stamp. The photo-tablet comes with a common set of pre-programmed keywords for each category, and users can enter their own using a touch-screen keyboard. Once a photo-tablet has been customized with names of the user's family and common travel destinations or photo-taking locations, most keyword assignments require only touching the appropriate words from an on-screen list. Users can also identify favorite photographs (the best from each event, trip, etc.).

Photos can be arranged automatically into albums, based on keywords, making it easy to create a "slide show" with a particular set of photographs. Printed albums can be produced on a local printer or can be produced by a tablet-server companion site and mailed.

By recording a voice annotation for selected photos, a story can be associated with each image. Thus, the oral history that corresponds to each photo, all too often lost once a picture is a few years old, is captured forever.

In a preferred embodiment, the photo-tablet will optionally perform automatic image enhancement, adjusting color saturation, brightness, and contrast. With a simple user assist (identifying the eyes), red eye can be automatically eliminated.

The photo-tablet is designed to be an intermittently connected Internet device. In a preferred embodiment, the user interface runs entirely on the photo-tablet, even for actions involving the server. User requests for network services (typically printing) are queued in the photo-tablet until the next connection (and the user is warned if much time has gone by with no connection.) When the photo-tablet is connected to the Internet, it finds the photo-tablet server, identifies itself, uploads any new photos, and uploads any orders for prints or other services. Photo-tablet software is automatically updated by the server to track changes in features and options. Photos that have been added to the tablet-server from other sources, such as a film processing and scanning provider or a PC, are automatically downloaded to the photo-tablet.

The photo-tablet is typically set to connect to the tablet-server late at night; it need only be connected to the tablet-server (e.g., via phone line dial-up to an Internet Service Provider) sometime before the scheduled hour. Thus, it requires Internet access only when people are generally sleeping, making relatively long connect times acceptable even without a dedicated line. As Table 1 shows, using the best-quality JPEG images from a 2-Mpixel camera yields an upload time of about 45 minutes for

10 pictures, and almost 3 hours for 36 pictures. With even a slow DSL or cable connection (384 Kbits/s), 36 pictures will take only 12.5 minutes, and 100 pictures (a busy day) would take only 35 minutes. With a 1.5-Mbit/s connection, which should be common by 2003, even 100 pictures will take less than 10 minutes.

Number of Pictures	Picture Size	Total Size	Modem 28.8 Kbits/s	DSL/Cable 384 Kbits/s	Fast DSL 1.5 Mbits/s
10	800K	8M	46	3.5	0.9
36	800K	28.8M	167	12.5	3.2
70	800K	56M	324	24.3	6.2
100	800K	80M	463	34.7	8.9

Table 1. Upload times, in minutes, for various connection speeds, assuming high-quality JPEG images from a 2-Mpixel camera and 80% utilization of the peak channel speed.

Increasing camera resolution will increase these times, but resolutions much beyond 3 Mpixels are unlikely to be popular in the next several years. Wavelet-based compression algorithms (planned for JPEG 2000) will produce much greater compression ratios, significantly reducing upload times.

The pictures are instantly available on the photo-tablet, without any need for a Web connection and without communication delays, since they are stored on the photo-tablet's hard disk. At the same time, they are automatically archived off-site, providing protection against loss and enabling access (password protected) to the photos from any Internet connection.

The tablet-server provides the primary archive for all photos. Any individual photo-tablet may not have enough storage to contain all the user's photos; if there are more photos on the server than can fit in the photo-tablet, the photo-tablet's disk is treated

as a cache. Typically, it would hold all the most recent photos, though the user can choose other selections (such as flagging certain groups of photos to always be included). Even a modest hard disk drive can hold thousands of high-resolution digital images, and it will not be long before economical hard disks will store tens of thousands of images.

In its highest-quality JPEG mode, a 2-megapixel camera produces images of approximately 800 Kbytes. A small hard disk today is 6 Gbytes, equivalent to 7,500 such images. With JPEG 2000 compression, the number of images may be increased more than tenfold.

The disk capacity can be substantially increased, at the user's option, if standalone local printing is not required. For this type of user, high-resolution image files are archived on the tablet-server, with only a screen-resolution image stored in the photo-tablet. Local printing can still be performed by downloading the required high-resolution files from the tablet-server.

The photo-tablet can also store photos delivered to the Web site from any source, enabling it to handle film-based photos as well as digital photos. The tablet-server can communicate with film-processing sites that deliver scanned images from film. photo-tablets can communicate with each other, or with a PC, through wired (USB), RF (Bluetooth), or IR connections. With a single command, the photos stored in two or more devices can be synchronized. Photo libraries (or individual photos or albums) can also be loaded into any photo-tablet from the tablet-server via the Internet.

Using photo-tablet PC software, photo-tablet owners who also have a PC can maintain a synchronized copy of their photo library on their PC's disk. Photos can be edited on the PC, and the modified copies automatically saved to the tablet-server (and then mirrored to the photo-tablet the next time it connects).

In a preferred embodiment, photos or photo albums can be printed to a local printer, connected via the photo-tablet's USB port.

The photo-tablet can optionally connect to a television or monitor for large-screen display. This option will become particularly attractive with the deployment of digital TV receivers, with their higher-quality displays.

Internet access for the photo-tablet will be provide by an ISP with an existing network of dial-up connections. As cable modems and DSL connections become widespread, along with home networks, the photo-tablet will be able to optionally connect via the home network.

Photo-tablet Hardware

Photo-tablets can be built in many different hardware configurations. Preferred embodiments share the following basic features and capabilities:

- Display: Backlit LCD with touch screen.
- User Interface: Touch screen plus a few hard buttons
- Memory Card Interfaces: SmartCard, Compact Flash, and Memory Stick
- Peripheral and PC Interface: USB port (and possibly a 1394 port)
- Mass Storage: hard drive, flash memory, or other technology

- Modem (or other form of Internet connection)
- Optional TV and RGB outputs
- Microphone and speaker
- Optional IR or RF (Bluetooth or 2.4-GHz) interfaces

Photo-tablet Implementation

In a particular illustrative embodiment, the photo-tablet has chassis features similar to a color Palm-size PC such as Casio's Cassiopeia, a Windows CE handheld computer. Such color Palm-size PCs sell today for $500 and have adequate color displays, touch screens, standard modems, and processing power for a photo-tablet. However, the photo-tablet will be approximately twice as thick as present color Pam-size PCs to accommodate a hard disk, a larger battery, and additional memory card (e.g., SmartCard and Memory Stick) interfaces.

Figure 2 shows a block diagram of an embodiment of a photo-tablet in accordance with the present invention. The central block, which includes the processor, system logic, and I/O controllers, will ultimately be built as a single chip. Early implementations will require three to six chips for these functions, in order to use standard processor and system logic chips and programmable logic, rather than ASICs.

In another embodiment, the photo-tablet has a complete single-board design created to provide exactly the features needed without additional assemblies. This embodiment will not require any custom ICs.

In a preferred embodiment, the photo-tablet incorporates nearly all the electronics on a single custom chip. In a another preferred embodiment, the photo-tablet uses a standard processor and a custom companion chip. This latter embodiment will reduce cost, size, and power consumption.

In a preferred embodiment, the photo-tablet hardware will use PC-compatible processors and system logic, leveraging the wide range of available products, but with not intention of maintaining full PC compatibility. An x86 microprocessor, while not the fastest, least expensive, or lowest power choice, will provide the best access to software. In addition, integrated processors with most of the required peripherals will be available. Even today, National's Geode chip provides most of the electronics required for the photo-tablet in a single device. Within two years, there will be a variety of such chips available. The photo-tablet will operate quite adequately with processor performance one or two generations behind the PC mainstream.

Photo-tablet and Tablet-Server Software

The photo-tablet is not just a device but is an integrated solution combining a device and an Internet server. Thus, there are two software components, one for the photo-tablet and one for the server.

In a preferred embodiment, the photo-tablet user interface software is developed using conventional high-level language tools. The photo-tablet user interface binaries should be run on a real-time operating system, such as Wind River's VxWorks, which will provide the basic Internet connectivity code as well as a user interface toolkit and file manager. Libraries need to be licensed (or developed) for photo manipulation

functions, such as JPEG compression and decompression, resampling, brightness and contrast adjustment, and other image enhancements. (An Adobe spin-off, PictureIQ, is currently licensing such software for embedded devices.)

The core software will be stored in Flash memory, enabling the system to run regardless of the state of the hard disk. Updates to the system software will be automatically loaded from the tablet-server when they are available and can be stored either on the disk or in the Flash memory.

All state information will be saved to the tablet-server each time it connects to a photo-tablet. Even in the event of a catastrophic disk failure, the photo-tablet can be fully restored by the tablet-server, except of course for any photos that have not yet been uploaded, as long as the hardware is still functional. In the event of a hardware failure, a user can restore all their images to a new photo-tablet.

Tablet-server

The tablet-server provides services to the photo-tablet. It is similar to a Web site but it communicates directly with the photo-tablet without requiring a browser or any user intervention. In a preferred embodiment, functions performed by the tablet-server include:

- Photo-tablet Management: Check software versions of photo-tablets when they connect and update software as needed.
- Picture Storage: Perform automatic backup of photos added to photo-tablet since last connection (and send to the photo-tablet any new photos added to the tablet-server from other sources, such as a PC).

- Picture Printing: Print in various sizes and qualities, on specialty items as well as on paper, using an assortment of vendors. The tablet-server will automatically translate print requests to the requirements of the appropriate vendor and communicate the order electronically. Formatted albums may be printed as well. (In most cases, these services will be provided by special companion Web sites.)

The special companion Web sites provide access to the user's photos from any computer, through a conventional Web interface. This site also allows photos to be shared with others via the Web.

Conclusion

Although the present invention has been described using particular illustrative embodiments, it will be understood that many variations in construction, arrangement and use are possible consistent with the teachings and within the scope of the invention. For example, bit-widths, clock speeds, and the type of technology used may generally be varied in each component block of the invention. Also, unless specifically stated to the contrary, the value ranges specified, the maximum and minimum values used, or other particular specifications, are merely those of the illustrative or preferred embodiments, can be expected to track improvements and changes in implementation technology, and should not be construed as limitations of the invention. Functionally equivalent techniques known to those skilled in the art may be employed instead of those illustrated to implement various components or sub-systems. It is also understood that many design functional aspects may be carried out in either hardware (i.e., generally dedicated circuitry) or software (i.e., via some manner of programmed controller or processor), as a function of implementation dependent design constraints and the technology trends of faster processing (which facilitates migration of functions previously in hardware into software) and higher integration density (which facilitates migration of functions previously in software into hardware).

The invention is further not limited to a specific expansion module technology as used in the illustrative embodiments. In specific but not limiting examples, the invention is equally applicable to any of the present and future variants of the CompactFlash (including any of the Type I, Type II, and proposed Type III variants), PC Card (including any of the 32-bit, 16-bit, Type I, Type II, and Type III variants),

and Springboard (or other open-back expansion module) standards, as well as other removable expansion module standards and technologies.

The invention is further not limited to a specific removable memory (or media) technology as used in the illustrative embodiments. In specific but not limiting examples, the invention is equally applicable to the use of present and future variants of MMCs, Miniature Cards, Memory Sticks, SSFDCs, Smart Cards, and SIM Cards.

The invention is further not limited to a specific network technology, topology, or scale. In specific but not limiting examples, the invention is equally applicable to networks at any scale including networks characterized as local area, departmental, enterprise wide, metropolitan area, state wide, regional, national, and the Internet.

All such variations in design comprise insubstantial changes over the teachings conveyed by the illustrative embodiments. The names given to interconnect and logic are illustrative, and should not be construed as limiting the invention. It is also understood that the invention has broad applicability to other applications, and is not limited to the particular application or industry of the illustrated embodiments. The present invention is thus to be construed as including all possible modifications and variations encompassed within the scope of the appended claims.